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THE AMERICAN METEOROLOGICAL JOURNAL.

A MONTHLY REVIEW OF METEOROLOGY.

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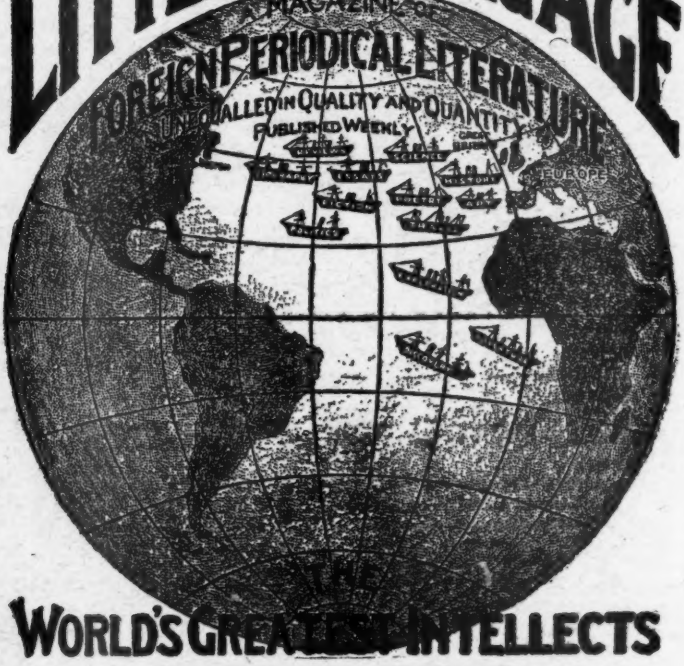

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THE AMERICAN

METEOROLOGICAL JOURNAL.

VOL. XII. BOSTON, MASS., APRIL, 1896. No. 12.

EDITORIAL NOTE.

A WORD OF FAREWELL.

IT is with great regret that we announce to the readers of the AMERICAN METEOROLOGICAL JOURNAL, and to the public at large, the suspension of its publication after the present number. This step has not been decided upon hastily, but only after the most serious consideration. The decision reached is the only one that seems possible under the existing conditions.

It is probably known to the readers of the JOURNAL that its publication has been attended with a very considerable financial loss on the part of the editors ever since its foundation in 1884. The JOURNAL could never have been started and maintained through the early years of its life without the very generous financial aid given it by Prof. Mark W. Harrington and Mr. A. Lawrence Rotch, and during the last few years it has only been continued at a further yearly loss on the part of the editor. This is equivalent to saying that the JOURNAL has not received the support from the country at large that it seems to the proprietors and editors to have deserved. As long as there seemed any prospect of obtaining this support, the voluntary financial assistance thus freely given it was gladly contributed. After a trial of twelve years, however, without any marked increase in the subscription list, those who have been most zealous in assisting the JOURNAL feel discouraged at the outlook, and see no other solution of the problem than a complete suspension of publication. In justice to the publishers, Messrs. Ginn & Co., of Boston, it should be stated that the decision to suspend

publication was reached by the proprietors alone, and was not in any way brought about by a desire to discontinue on the part of the publishers, even though the JOURNAL has every year caused them a pecuniary loss.

The sense of regret which the proprietors and editors feel in making the present announcement has a distinctly national tinge, for the reason that the discontinuance of this publication means that the workers in meteorology in the United States cannot, or will not, support such a magazine. However much we may deplore this fact, it nevertheless remains a fact, and American Meteorology is now left without a representative independent organ, such as it has been our aim to make the JOURNAL. Before, however, drawing any general conclusions from this statement of fact, it must be remembered that the condition of things as to meteorological publications in the United States is rather different from that which exists in most other countries. Here in the United States we have a National Weather Bureau which is constantly sending out from its Central Office, in Washington, with a liberality which does not cease to astonish those who are not accustomed to such a free distribution of publications, hundreds of thousands of weather maps, crop bulletins, storm and snowfall charts, Monthly Weather Reviews, reports and special investigations. These publications are sent free of charge to thousands of volunteer observers, libraries, colleges, schools, and private individuals, and in this way a great store of meteorological information is constantly brought before our people, either directly, in the form of the original publications, or indirectly, through the daily papers. There are, further, the local monthly bulletins of the different State Weather Services, which are widely distributed among the volunteer observers in every State, and several of which contain notes on meteorological matters, besides the usual tables. In this way those of our people who are really interested in learning something of the science of meteorology have brought constantly to their attention more or less information of one sort or another, and, not unnaturally, are as a whole disinclined to seek for further meteorological literature, such, for instance, as this JOURNAL furnishes. We do not wish to be understood as saying that the JOURNAL has not had a field of its own, nor as stating that the official Weather Bureau publications have given our volunteer observers, and others, all

that they need in the way of meteorological information. We are sure that the great majority of those who are connected with our Weather Bureau will agree with us in our belief that this magazine has supplied a vast amount of general information not contained in the official meteorological publications of the Bureau, a knowledge of which would have made our volunteer observers more careful and more intelligent in their work, and would have still further added to the advance of our science in the United States. We have thought it but justice to our country to say these few words of explanation. The fact remains, nevertheless, that this JOURNAL has not received the support it should have had to warrant its continuance.

With the suspension of the publication of this JOURNAL there remains no representative independent meteorological publication in the United States. This is certainly a most discouraging, not to say humiliating, condition of things. It is earnestly to be hoped that in the near future some arrangements may be made for the foundation, on a sound financial basis, of a new publication, which shall carry on the work this JOURNAL has been trying to do, under extremely adverse circumstances, during the past twelve years. We are in a position to state, and we do so state with pleasure, that plans are already being formulated looking towards this end. Whatever may be done in the future, however, this JOURNAL, as the AMERICAN METEOROLOGICAL JOURNAL, and under its present ownership, comes definitely to an end with the present number.

It may not be out of place to refer briefly, on this occasion, to some points in the history of the JOURNAL. It was founded in 1884 by Prof. Mark W. Harrington, then Professor of Astronomy in the University of Michigan and Director of the Observatory at Ann Arbor. The first number was issued in May of that year. Mr. A. Lawrence Rotch, Proprietor of the Blue Hill Meteorological Observatory, became associated with Prof. Harrington on the editorial board with the beginning of Vol. III., in May, 1886, and in May, 1889, Prof. W. J. Herdman, M. D., of the University of Michigan, became one of the editors. No further change was made until May, 1892, when the JOURNAL was transferred from Ann Arbor, where it had, up to that time, been published, to Boston. Prof. Mark W. Harrington, who, in July, 1891, began his duties as Chief of the Weather Bureau,

then retired from the active editorship, and Mr. Robert DeC. Ward, Assistant in Meteorology in Harvard University, Cambridge, Mass., took his place. A board of Associate Editors was then formed, consisting of Prof. Mark W. Harrington, Chief of the United States Weather Bureau; Mr. A. Lawrence Rotch, Proprietor of the Blue Hill Observatory; Prof. Cleveland Abbe, of the Weather Bureau in Washington; Prof. William M. Davis, of Harvard University, and Mr. Everett Hayden, Marine Meteorologist of the United States Hydrographic Office in Washington. In July, 1895, Mr. Oliver L. Fassig, Librarian of the United States Weather Bureau, joined the board of Associate Editors. A review of the papers that have appeared in this JOURNAL, and of the work it has tried to do, seems to us out of place at the present time. Ferrel and Loomis have contributed to its pages. There is no need to go beyond those names to show that our JOURNAL has had the support of the best contributors our country could give.

Although this editorial has already far exceeded reasonable limits, there are a few words more directly of a personal nature, which the present editor asks permission to make. When the JOURNAL was transferred from Ann Arbor to Boston in 1892, Prof. Harrington, on account of his official duties as Chief of the Weather Bureau, resigned his position as editor, and the present editor took his place. Prof. Harrington's successor as editor came to that position with absolutely no experience in editorial work. The task which devolved upon him in editing the JOURNAL, with his inexperience, the confusion attending the change of place of publication, the financial losses incident to its continuance, and other like matters, was very great indeed. He was more than once nearly discouraged with the prospect. That he was not so discouraged, and that he was persuaded to continue the JOURNAL, was due principally to the letters he then received from meteorologists at home and abroad, many of them entirely unknown to him except by name, bringing words of appreciation and of encouragement, and speaking in the highest terms of the work the JOURNAL had done and was doing for American Meteorology. Such letters as these, which have been coming in from time to time throughout the past four years, have done far more than their writers ever could have expected or hoped they would accomplish, in the way of encouraging

and rewarding the efforts which have been made to keep this JOURNAL up to the high standard set for it at its foundation. To all those who have thus written or spoken words of appreciation and approval the editor wishes publicly to express his thanks.

It is a hard task to lay down this work. It is hard to say the last word which shall close the final volume of the AMERICAN METEOROLOGICAL JOURNAL. We have been looking forward for some months to the time when we should be relieved of the editorial work involved in its publication, and could take up our other duties which are crowding in upon us from all sides, but now that the moment has arrived for taking this step, we take it most regretfully. That the AMERICAN METEOROLOGICAL JOURNAL may have contributed in some way to the development of American Meteorology is our most sincere hope.

ROBERT DEC. WARD.

IN view of the fact that the discontinuance of this JOURNAL leaves this country without any publication in which matters of general interest to meteorologists are regularly printed, arrangements have been made with the editor of *Science* (New York), whereby the editor of this JOURNAL, will contribute to *Science* current notes in meteorology. It is intended that these notes shall contain short abstracts and reviews of all the important meteorological publications which appear from week to week, on the same general plan as that followed in the Current Notes department of this JOURNAL. In order that this new department of *Science* may be made as complete as possible, the editor of this JOURNAL most earnestly requests that the institutions and the individuals that have been sending him their publications during the past four years, for review in the JOURNAL, may continue to do so in the future. In return he will be glad to send to them copies of *Science* containing notice of these publications, and also any papers that he himself may publish from time to time. All matter thus sent should be addressed as follows: ROBERT DEC. WARD, Harvard University, Cambridge, Mass., U. S. A.

MESSRS. GINN & CO., publishers of the JOURNAL, will continue to supply any back numbers of the JOURNAL bearing dates later than April, 1892.

A SPECULATION IN TOPOGRAPHICAL CLIMATOLOGY.

PROF. W. M. DAVIS.

Relation of Climate and Topography. — There are certain phases in the general progress of the denudation of the lands that merit the attention of meteorologists for two reasons. *First,* because the explanation of various existing topographic features now in process of formation requires a recognition of their close dependence on existing climatic conditions, a correlation of climate and topography being thus induced. *Second,* because the interpretation of various other features of more ancient origin leads to an understanding of the climatic conditions under which they were produced; the correlations gained from the study of existing conditions enabling us to infer the vanished climates of the past by means of their still-preserved topographic products.

Under the first category thus implied, the sand dunes of arid deserts may be placed as the most elementary and apparent example; the extensive alluvial fans and "wash" slopes of arid piedmont areas, and the long, smoothly graded "waste" slopes on arid mountain sides of mature dissection, are examples of less general recognition. The ice and snow deserts, as well as the gravel deltas and morainic ridges of Greenland and Alaska, also belong in the first category, these being associated with existing cold and damp climates, as the preceding were with existing warmer and dry climates.

Under the second category would fall the pleistocene glacial deposits of northeastern America and northwestern Europe, to which so much attention has been given; with these, river terraces are often associated, although their history is complicated with the possibility of land movement as well as of climatic change. Here also belong the plains that represent ancient lake floors and the extensive systems of lake beaches and cliffs around the great basins of the west and around our Great lakes (accepting the Newberry-Gilbert hypothesis of the origin of the latter); all these being interpreted as the product of cooler

climates than those of to-day. Among the less manifest forms of this category, mention may be made of the discordant valley floors of the Finger lake region of western New York, lately described by Tarr,* and well used by him to demonstrate the glacial origin of the Finger lakes themselves; also, the refreshed cliffs of the trap ridges in the Connecticut valley, whose strength of form has seemed to me to depend on the scouring of the region by ice.† Among more disputed products of former colder climates are many large lake basins, the cirques at the upper end of mountain valleys, and the submerged basins of fiords, concerning all of which there is an extended literature. It is manifest that according to the observer's confidence in his interpretation of these various forms, he will reconstruct a more or less definite picture of the extinct climates under which they were formed, and thus extend meteorology into a historical science, greatly to its advantage.

Former arid climates are less generally recognized than former colder climates; the topographical forms associated with aridity having been less attentively studied than those produced by glaciation; but several examples of former arid climates may be quoted. Gilbert has argued the existence of a dry climate in the region of Great Salt Lake, anterior to the period in which the high-level beaches and cliffs were formed, from the existence of ancient alluvial fans.‡ Hicks has inferred a dry climate for a part of the great plains of Nebraska anterior to the deposition of the quaternary sediments of Lake Cheyenne, because they undulate in such a manner as to imply a foundation of sand dunes. Penck has explained the courses of numerous streams in the neighborhood of the Plattensee of Austria as consequent on the arrangement of sand ridges that were accumulated during a former drier climate.‖

Climatic Consequences of displacing the Poles.— The pleistocene glacial period has usually been studied as if it involved only a change towards refrigeration; hence records of aridity are not expected contemporaneous with those of glaciation. But there is one explanation of the glacial period, and a very simple one, that involves a consideration of the topographic products of dry

* Bull. Geol. Soc. Amer., v., 1894, 339-356. † Amer. Geol., iii., 1889, 14-18.

‡ Monogr. I., U. S. Geol. Surv., 220. § Bull. Geol. Soc. Amer., ii., 1891, 29.

‖ Morphol. der Erdoberfläche, ii., 45.

as well as of cold climates; this is the supposition that the pole of the earth was, during the glacial period, located near Iceland.

It has been very thoroughly demonstrated by mathematicians and astronomers that such a displacement of the pole is an inadmissible explanation of the glacial period, because the pole cannot be displaced; but the oscillations of the earth's axis, recently discovered by Chandler, were declared impossible by a high mathematical and astronomical authority, even after their existence was announced; and their possibility — that is, their explanation logically deduced from accepted postulates — was allowed only after an insistence on their existence and a reconsideration of the mathematical argument that at first proved them impossible. In very much the same way, the demands of geologists and biologists on the duration of past time have been resisted by certain physicists, on the ground that the whole period of time since the earth's crust was formed could not have been so great as geologists thought necessary for the performance of geological processes or so great as biologists thought necessary for the evolution of species; but any one who has followed the arguments of the physicists in this matter must perceive that the strength of their results is not to be measured only by the perfection of the calculations through which the results are deduced, but also by the correctness of the fundamental postulates on which all the deductions are based. As these postulates are reconsidered and altered, the conclusions based upon them vary greatly. The conclusion that the non-mathematical geologist draws from all this is that, after all, he may as well go on observing and generalizing and calculating in his own small way, without regard to the limits which mathematicians set to his results; and if any conclusions that he reaches tend strongly against the deductions of the mathematicians, they will perhaps in time discover a new value of their postulated constants, so as to bring their deductions better into accord with the results of geological observation. It is therefore advisable that geologists should continue to make their own measure of the earth's time scale by studies of the rate of denudation and deposition; they should by no means cease this kind of observational study and accept the dicta of the physicists. In the same way, students of geological climates may be advised not to accept too confidently the warnings of astronomers: they had

better look over the earth and see what really happened in pleistocene time, rather than contentedly declare in advance of observation that this or that climatic condition could not have happened. If the astronomers' deductions are confirmed by observation they will stand, doubly supported; if they are shown to be erroneous, the astronomers will probably find the seat of their error in the omission of some essential postulates. Hence, without in the least intending to pre-announce any results, but desiring solely to point out the direction in which certain critical observations may be made, the following speculations are laid before the reader: —

The rearrangement of many of the geographical conditions that would accompany the displacement of the pole may be deduced with considerable safety. They have been considered by a number of speculative geologists and climatologists. Assuming the pole in latitude 70° N. on the meridian of 20° W., the following three classes of effects may be accepted with less or greater confidence. First, a rearrangement of shore lines in consequence of the adoption of new locations of polar flattening and equatorial bulging; these changes are difficult of definition. Second, alteration in the paths of ocean currents, of which one of the most important would be the diminution of the volume of warm water transferred from the southern to the northern hemisphere by the oblique cross-equator current of the Atlantic and thus the great loss of importance in the extension of the Gulf stream into the North Frigid zone. Third, a change in the location of the wind and rain belts, their boundaries being shifted twenty degrees southward in the meridian of Iceland, the same amount northward on the opposite meridian which passes somewhat east of New Zealand, and remaining essentially unchanged at the half way points, which are located near the meridians of Ceylon and the Galapagos.

It is plain that these changes in the limits of the wind and rain belts would tend not only to glaciate northwestern Europe and northeastern America — the regions of the greatest expansion of pleistocene ice sheets — but would also place arid trade-wind climates on the northern side of the belt now occupied by the equatorial rains of Africa and South America, and at the same time place the equatorial rains on the northern margin of the arid land areas now found in the southern parts of these con-

tinents. On the adoption of the present location of the poles, the changes would be reversed. Various other consequences would follow the shift in the location of the pole, but those just mentioned will suffice to show the direction in which this speculation trends.

Now if the northern side of the equatorial rain belt in Africa and South America is found to possess topographical records of a wet climate recently succeeding a dry climate, and if the features of the region south of the same belt indicate a dry climate following a wet climate, some color of truth would be lent to this speculation; but if these indications are wanting, the speculation would remain as little founded as it is to-day. It is a matter of absolute indifference to me whether the speculation is ultimately proved correct or completely disproved; it is the quality of proof or disproof that interests me. At present, the disproof of the speculation rests almost wholly on deductive mathematical argument; and however safe and strong this is, its confirmation by an entirely independent line of reasoning should not be neglected. Torrid Africa and South America therefore offer an attractive field for a new kind of investigation, interesting alike to meteorologists and physiographers; and although it is impossible for many of us to go there and undertake the investigation on the ground, it is, nevertheless, possible for the stay-at-homes to have some share in the work by aiding in the preparation for it; that is, by outlining the topographical features which may characterize a given climate, or a given succession of climates.

Existing accounts of these regions do not suffice to answer the questions that the meteorological speculator asks, because travellers who leave the temperate seats of civilization and penetrate the torrid zone seldom go there with the preparation necessary to enable them to see the critical facts. It would be as impossible for a botanist to determine the species of plants seen by a traveller ignorant of botany, as for a meteorologist to infer the character of past climates from the narrative of an observer unversed in the relations of topography to climate. However plainly the facts stand before him, the observer seldom sees and records facts of a kind that he is not prepared to see. It is only from the rare Darwins and Danas that we get record of facts that are obscure because unexpected.

Topographical Records of Arid and Humid Climates. — The relation of topography to climate, and the inference of climatic conditions from observations on topographic form, involve a careful consideration of the angle of descent assumed by the waste of the land as it travels along valleys towards the sea. In dry regions, it seems as if the waste supplied by disintegration washes and creeps down into the valleys before it has been reduced to fine texture. In wet countries, the presence of vegetation detains the transportation of rock waste down hillsides, and thus gives time for the more complete disintegration of the waste; indeed, the presence of vegetation aids directly in the processes of disintegration. As a consequence, the streams in wet regions, although well supplied with water, are comparatively slowly supplied with waste; and much of the waste that they have to carry comes to them fine-textured; hence they cut down their valley lines to moderate or faint slopes, before reducing their ability to do work to equality with the work which they have to do; that is, before "grading" their channels. But in dry regions, the rock waste is hurried down the valley sides before it has time to weather to fine texture; and in the valleys the streams are of small volume, and hence cannot sweep away the waste unless a comparatively steep slope is allowed them. In other words, the grade assumed by the small streams of an arid region will be doubly steeper than the grade assumed by the large streams of similar catchment basins in a humid region.

Examples of steep-graded accumulations of coarse waste may be found in existing arid regions; and the observer who is practised in their recognition might profitably explore other regions, possibly once arid, to discover whether traces of such steep-graded accumulations existed there in more or less dissected form. The reports of western surveys give many examples of alluvial fans, the largest being those described by Hilgard* in southern, and by Fairbanks† in southeastern California. Several fans near San Bernardino are mentioned as having radii of ten, twelve, or even fourteen miles, the head of the fans standing four hundred, six hundred, or even seven hundred feet above the frontal margin. Fans so large and steep as these must be expected only in mountainous arid regions.

It is important to recognize that these enormous accumula-

* Bull. Geol. Soc. Amer., iii., 1892, 124–127. † Amer. Geol., xvii., 1896, 69–71.

tions of rock waste stand in essential connection with the climate of arid mountain regions, just as essential to them as their barren surface, although much less generally mentioned. They are not only conspicuous signs of existing dry climate; their volume is so great that they must long retain a recognizable form even in a succeeding moister climate. To meteorologists who are concerned not only in reading the rain gauges of to-day, ancient alluvial fans are of great import.

It is not simply by the formation of individual fans of great size that piedmont districts of arid climate are characterized. The laterally confluent fans from many mountain ravines frequently unite to form what is, in the West, known as the "wash"; a long inclined plane of waste sloping outward from the mountain flanks, and backing up upon them as it grows forwards. King and Emmons have given good accounts of these singular accumulations in the troughs between the parallel ranges of the Great Basin of Utah and Nevada* but "wash" slopes have not yet gained the place that they deserve in the description of arid regions; perhaps in part on account of their unfortunate name. These desolate inclined planes are truly important topographic features in arid piedmont regions. In the Great Basin, they bank up against the mountain flanks to a height of 1,000 or 2,000 feet, sloping at an angle of a few degrees towards a medial depression. Blanford describes similar wash slopes at the base of the arid mountains of Central Persia.† In regions of similar general form, but of more humid climate, less waste would be found lodged in the lower valley courses and on the flanks of the mountains; a greater share of the waste would be washed down towards the sea, forming low-grade flood plains and deltas.

Topographical Records of Changing Climates. — Let us now consider the effect of the introduction of a dry climate in a region where rainfall had formerly been plenty, and of a wet climate in a region that had previously been arid.

The deep-cut valleys of the formerly wet region would be aggraded and clogged with waste as the climate became drier. Alluvial fans and wash slopes would be spread along the piedmont belts, backing up into the dissected mountain flanks.

The steep-graded valley floors and waste slopes of a formerly dry region would be degraded and trenched as the climate

* 40 Par. Survey, i., 1878, 460, 484–486; ii., 1877, 470.

† Quart. Journ. Geol. Soc. (London), xxix., 1873, 493–503.

became wetter. For some time after the climatic change, the accumulations of waste of the former arid period would continue to be perceptible; but they would gradually disappear, and thus complete adjustment to humid conditions would be introduced.

It should be noted, however, that the elevation of a region will produce certain changes comparable to those here stated as resulting from an increase of rainfall. As soon as elevation allows the streams to entrench themselves to a greater depth than before, they will proceed to incise their channels beneath the valley floors, alluvial fans, and wash slopes, on which they ran contentedly before. If the elevation be sufficient, all the waste before accumulated may be washed away, and a considerable time may elapse before the country is worn down low enough to allow the waste to accumulate again in large quantities. It may be for this reason that the dry plateaus across which the deep canyon of the Colorado is cut now have comparatively little waste. During their long stand at a lower level — as proved by Powell and Dutton — much waste must have cloaked them; but all this seems to have slid down into the canyon that has been cut in consequence of elevation, leaving much of the upland surface comparatively bare. Distinction must therefore be made, if possible, between the effects of a climatic change towards greater rainfall and of an epirogenic movement to greater elevation. Valid ground for this distinction might often be found in the tendency of streams in elevated regions to cut canyons in their former valley floors along their lower courses during and for a time after the elevation of their basins; while in regions where a moist climate had succeeded a dry climate without vertical movement, this tendency might be largely counteracted by the plentiful supply of waste derived from the upper streams and quickly washed down to the lower courses, whereby they might for a time even tend to aggrade their flood plains.

It is, however, not only in stream grades that topographical climatology may be studied. The relation of lakes to climatic conditions is very close, and it has been frequently and fully discussed. It may be stated at once that with the pole near Iceland, basins on the northern side of the equator and not far from it in Africa and South America would be discharged by evaporation rather than by overflow; while at present, lakes would fill the basins, overflow would be established, and their

waters would lie against alluvial fans, just as the waters of Bonneville lay against the fans of the pre-Bonneville dry period. The existing outlets of these lakes would exhibit features of youth, like those which must have characterized the northward discharge of Bonneville over Red Rock pass.

Basins on the southern side of the equator in the continents bordering the Atlantic would, on the contrary, exhibit at present a disposition to shrink from their former shore lines ; and their outlets would wither away, thus repeating with more or less distinctness the features of the withering Bonneville. These contrasted results of a shift in the equatorial rain belt on either side of the existing equator make the detection of such a shift seem not impossible, if it occurred within pleistocene time. The relation of Lake Tanganyika to the Lukuga river deserves examination in this connection.

The Topographical Consequences of Various Glacial Theories. — A few final paragraphs may be devoted to sketching the contrast between the consequences of various theories of the glacial period, in so far as they are expressed in the relations of topographical form to climate, as here discussed. General refrigeration, maintaining the same difference of temperature between equator and poles as at present, but lowering the temperature everywhere, would maintain a general atmospheric circulation of about the present activity, except for a little loss of velocity due to the less contrast in humidity between torrid and frigid zones. No significant shift in the wind belts and rain belts would be produced ; and if they varied at all, the variation would be symmetrical in the two hemispheres. The equatorial rainfall would be somewhat decreased by reason of the somewhat lower temperature at which it would occur, but the two sides of the equator would suffer alike. The subtropical winter rainfall of the northern Sahara would not encroach so far as now on the desert, by reason of the weakening of the general circulation.

Local refrigeration, due to elevation of the glaciated areas, would have no essential or systematic association with climatic and topographic changes elsewhere.

Long and severe winters and short hot summers during times of great orbital eccentricity — according to Croll's hypothesis — would be characterized by a stronger circumpolar circulation of the atmosphere in the winter hemisphere. Two consequences follow from this. The subtropical winter rains on the border of

the torrid zone would encroach further upon the trade-wind deserts; and the winter precipitation in continental interiors would become heavier, if the theory advocated by Hann for the origin of cyclonic storms in temperate latitudes holds true. These changes would be essentially symmetrical in the two hemispheres; the effect of greater rainfall on the polar side of the trade wind deserts might be noticeable.* No significant effect is to be expected under the equatorial rainbelt.

The hypothesis of a displaced pole introduces results strongly unlike the preceding, especially on the Atlantic continents of the southern hemisphere. While the polar borders of the Sahara would have been more rainy under this hypothesis as well as the preceding, the polar border of the Kalahari desert would have been drier under this hypothesis and moister under the preceding. While the Soudan might perhaps have received less subequatorial rainfall during the short hot summer of Croll's hypothesis as well as during the displacement of the equator southward under the present hypothesis, the belt of subequatorial rainfall south of the existing equator would have been distinctly moister in one case and somewhat drier in the other. Similar consequences and contrasts may be deduced for the West Pacific region, but there is little land on which they can be there applied.

I have made no special search through geographical literature to discover if reported facts give countenance to one set of these deduced consequences more than to another; but the dwindling of Lakes Tanganyika and Aullagas, in Africa and South America, respectively, may possibly be cases in point. It is believed, however, that search for accidentally recorded facts will not greatly advance the settlement of the problem. What is wanted is exploration of the most critical regions by well-trained topographical climatologists, with the points at issue clearly in mind. Whatever theory the facts of observation support is immaterial; preference for this theory or that should have no place in the search for facts; but intimate and critical acquaintance with the consequences of various proposed theories gives good companionship in exploration. As well search for the pole without knowing how to find it by observations for latitude, as search for the secrets of tropical records of the glacial periods without training in topographical climatology.

HARVARD UNIVERSITY, March, 1896.

* See this JOURNAL, xi., 1895, 441–444.

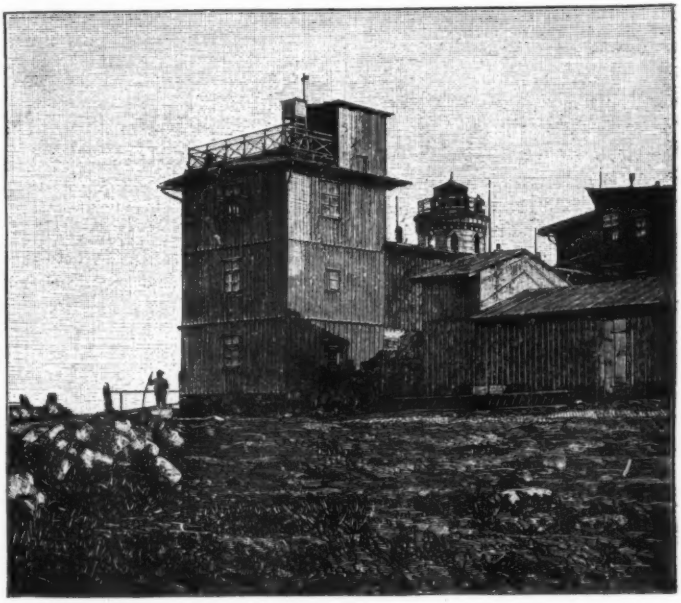
THE NEW METEOROLOGICAL OBSERVATORY ON THE BROCKEN.

A. LAWRENCE ROTCH.

Location and History. — The Brocken, in the Harz Mountains, which has an elevation of 3,750 feet above the sea and is the highest mountain in Northern Germany, is of great importance as a meteorological station. It lies just south of the usual track of storms crossing the North Sea, and in connection with Ben Nevis in Scotland, which is on their northern border, is capable of furnishing valuable synoptic data. Moreover, the precipitation on the Brocken, although known to be excessive, has not yet been accurately determined.

Meteorological observations, with some interruptions, were made by the keepers of the hotel on the summit of the Brocken from 1836 to 1869. Since 1880 unsuccessful attempts to maintain a secondary meteorological station in the hotel have been made by Dr. R. Assmann, though the co-operation of the mountain clubs and the Prussian Meteorological Institute, the chief difficulty being that a skilful observer did not remain throughout the year. A description of the location, equipment, history, and prospects of the station in 1885, with a *résumé* of the climate were given by the writer in the JOURNAL, Vol. II., No. 10. In 1890 the observations again ceased, but now Dr. Assmann's persistent efforts to establish a permanent station have been successful, since the Principality of Wernigerode, which owns the Brocken and the buildings thereon, aided by the provincial authorities and Alpine clubs to the amount of $1,000, has built and equipped an observatory which it is expected the Prussian Meteorological Institute will maintain as one of its first-order stations. Observations were commenced last October, and this realization of his project is described by Dr. Assmann in *Das Wetter* for July and December, 1895, from which these facts are derived, as well as the accompanying picture of the observatory as it appears from the northwest.

Construction and Equipment. — The observatory consists of a three-story wooden tower adjoining the north gable of the hotel, designed to furnish a dwelling for the observer, a room for the



THE BROCKEN OBSERVATORY FROM THE NORTHWEST.

instruments with a platform above for their exposure, and another room for the accommodation of scientists who may desire to pursue investigations here. The cellar and lower story are the observer's quarters, the third story contains the observing and instrument room and between them is the so-called *Gelehrten Zimmer.* For the construction of the observatory wood was chosen as the material best adapted to resist the extreme cold and damp which here prevail. The double walls enclose an air space and the sheathing is lined on the inside with paper and linoleum.

Each story contains a single room, 18x14.7 feet square and about nine feet high, with windows facing north, east, and west the masonry chimney occupying the south wall. In the upper story, the observer's room, which overtops the roof of the hotel stable, has a window looking south, so that from here a view in all directions is obtained. All the windows are double and have storm shutters. A door in the lower story gives access to the adjacent hotel but the main entrance to the observatory, protected by a "wind screen," is on the east side. The flat and double paper roof carries a platform of wood surrounded by a railing, and above it on the south rises the massive chimney wall which serves as a support for some of the instruments. Nevertheless, at times, on account of the great violence of the wind, the whole building trembles. Only the lower rooms are heated by stoves burning anthracite coal, and owing to the extreme cold and wind these may at times prove insufficient.

The instrumental equipment of the observatory is as follows: In the instrument room are a compensated barometer of Fuess, a Richard barograph, a nephoscope, and several extra instruments. A novel device, for use at night in reading the exterior instruments, is a battery charging an accumulator which operates incandescent electric lamps, one being fixed in the thermometer shelter and another portable one with a pocket accumulator being employed in reading the rain-gauges, etc. A lantern would be at once extinguished by the high winds, and without this light many observations would be lost. A large Stevenson shelter on the roof contains the usual thermometers and also a Richard thermograph and hygrograph, but since, on account of the frost-work (*Rauhreif*) in winter, these instruments are often incased hermetically in ice, at such times Assmann's aspiration

psychrometer (see description in Journal, Vol. VIII., No. 5,) is to be substituted. This is exposed near the entrance to the observatory for a few minutes only, previous to the observation, so that there is not time for the frost-work, here accumulating with great rapidity, to form upon the instrument which at other times is kept in a cool place and the condensation of moisture upon it is thereby avoided. By reason, also, of this frost-work an anemometer cannot be maintained in continuous action, consequently the wind velocity at the hours of observation is obtained from a small Robinson anemometer which is exposed during one minute on a pole and, like the aspiration psychrometer is kept in a "cold-room." The spindle of the wind-vane pierces the roof and terminates in an arrow moving around a wind-rose, thus permitting the direction of the wind to be seen from the observer's room. A sunshine recorder is exposed either on the roof or on a pillar. The most difficult element to deal with is, undoubtedly, the precipitation and, for this purpose, three large gauges are exposed 6.5 feet above the ground on the north, east, and south sides of the hotel buildings, so that at least one of them should always be sheltered from the wind and give a fairly accurate measure of the rain or snow.

Observer and Observations. — In order to diminish the expense to the Meteorological Institute it is necessary that during the summer the observer should be postal and telegraph clerk at the hotel and during the winter that he should aid the care-takers there for which services he receives payment and free board An observer to fulfil these requirements has been found in one Koch who has received a course of instruction at the Meteorological Institute in Berlin.

Observations of all elements are made at 7 A. M., 2 and 9 P. M.; and if they can be carried out as proposed not only will the climatic conditions of the Brocken be determined accurately, but important contributions will be added to our knowledge of the upper air. At present there is no telegraphic communication with the summit of the Brocken in winter, but in the future it is possible that by means of a cable laid on the ground the Brocken observations may be transmitted to Hamburg to be utilized in the synoptic chart and predictions of the *Deutsche Seewarte.*

CURRENT NOTES.

The Composition of Expired Air and its Effects upon Animal Life.— A memoir with the above title has recently appeared as Smithsonian Contributions to Knowledge, No. 989. It is by Drs. J. S. Billings, S. Weir Mitchell, and D. H. Bergey, and gives the results of an investigation carried on under the Hodgkins Fund. The memoir is an important one, and the following paragraphs present the conclusions derived from the study.

I. The results obtained in this research indicate that in air expired by healthy mice, sparrows, rabbits, guinea-pigs, or men, there is no peculiar organic matter which is poisonous to the animals mentioned (excluding man), or which tends to produce in these animals any special form of disease. The injurious effects of such air observed appeared to be due entirely to the diminution of oxygen, or the increase of carbonic acid, or to a combination of these two factors. They also make it very improbable that the minute quality of organic matter contained in the air expired from human lungs has any deleterious influence upon men who inhale it in ordinary rooms, and hence it is probably unnecessary to take this factor into account in providing for the ventilation of such rooms.

II. In ordinary quiet respiration, no bacteria, epithelial scales, or particles of dead tissue are contained in the expired air. In the act of coughing or sneezing, such organisms or particles may probably be thrown out.

III. The minute quantity of ammonia, or of combined nitrogen, or other oxidizable matters found in the condensed moisture of human breath, appears to be largely due to products of the decomposition of organic matter which is constantly going on in the mouth and pharynx. This is shown by the effects of cleansing the mouth and teeth upon the amount of such matters in the condensed moisture of the breath, and also by the differences in this respect between the air exhaled through a tracheal fistula and that expired in the usual way.

IV. The air in an inhabited room, such as the hospital ward in which experiments were made, is contaminated from many sources besides the expired air of the occupants, and the most important of these contaminations are in the form of minute particles, or dust. The experiments on the air of the hospital ward, and with the moisture condensed therefrom, show that the greater part of the ammonia in the air was probably connected with dust particles which could be removed by a filter. They also showed that in this dust there were micro-organisms, including some of the bacteria which produce inflammation and suppuration, and it is probable that these were the only really dangerous elements in this air.

V. The experiments in which animals were compelled to breathe air

vitiated by the products of either their own respiration or by those of other animals, or were injected with fluid condensed from expired air, gave results contrary to those reported by Hammond, by Brown-Séquard and d'Arsonval, and by Merkel, but corresponding to those reported by Dastre and Loye, Russo-Giliberti and Alessi, Hoffmann-Wellenhof, Rauer, and other experimenters referred to in the preliminary historical sketch of this report, and make it improbable that there is any peculiar volatile poisonous matter in the air expired by healthy men and animals, other than carbonic acid. It must be borne in mind, however, that the results of such experiments upon animals as are refererd to in this report may be applicable only in part to human beings. It does not necessarily follow that a man would not be injured by continually living in an atmosphere containing two parts per one thousand of carbonic acid and other products of respiration, of cutaneous excretion, and of putrefactive decomposition of organic matters, because it is found that a mouse, a guinea-pig, or a rabbit seems to suffer no ill effects from living under such conditions for several days, weeks, or months; but it does follow that the evidence which has heretofore been supposed to demonstrate the evil effects of bad ventilation upon human health should be carefully scrutinized.

VI. The effects of reduction of oxygen and increase of carbonic acid to a certain degree appear to be the same in artificial mixtures of these gases as in air in which the change of proportion of these gases has been produced by respiration.

VII. The effect of habit, which may enable an animal to live in an atmosphere in which, by gradual change, the proportion of oxygen has become so low, and that of the carbonic acid so high, that a similar animal brought from fresh air into it dies almost immediately, has been observed before, but we are not aware that a continuance of this immunity produced by it had been previously noted. The experiments reported in the Appendix, VII., 17 to 28, show that such an immunity may either exist normally or be produced in certain mice, but that these cases are very exceptional, and it is very desirable that a special research should be made to determine, if possible, the conditions upon which such a continuance of immunity depends.

VIII. An excessively high or low temperature has a decided effect upon the production of asphyxia by diminution of oxygen and increase of carbonic acid. At high temperatures the respiratory centres are affected, where evaporation from the skin and mucous surfaces is checked by the air being saturated with moisture; at low temperatures the consumption of oxygen increases, and the demand for it becomes more urgent.

So far as the acute effects of excessively foul air at high temperatures are concerned, such, for example, as appeared in the Black Hole at Calcutta, it is probable that they are due to substantially the same causes in man as in animals.

IX. The proportion of increase of carbonic acid and of diminution of oxygen, which has been found to exist in badly ventilated churches, schools, theatres, or barracks, is not sufficiently great to satisfactorily account for the great discomfort which such conditions produce in many persons, and

there is no evidence to show that such an amount of change in the normal proportion of these gases has any influence upon the increase of disease and death-rates which statistical evidence has shown to exist among persons living in crowded and unventilated rooms. The report of the commissioners appointed to inquire into the regulations affecting the sanitary conditions of the British army, properly lays great stress on the fact that in civilians at soldiers' ages in twenty-four large towns, the death-rate per one thousand was 11.9, while in the foot-guards it was 20.4, and in the infantry of the line 17.9, and showed that this difference was mainly due to diseases of the lungs occurring in soldiers in crowded and unventilated barracks. These observations have since been repeatedly confirmed by statistics derived from other armies, from prisons, and from the death-rates of persons engaged in different occupations; and, in all cases, tubercular disease of the lungs and pneumonia are the diseases which are most prevalent among persons living and working in unventilated rooms, unless such persons are of the Jewish race. But consumption and pneumonia are caused by specific bacteria, which, for the most part, gain access to the air-passages by adhering to particles of dust which are inhaled, and it is probable that the greater liability to these diseases of persons living in crowded and unventilated rooms is, to a large extent, due to the special liability of such rooms to become infected with the germs of these diseases. It is, however, by no means demonstrated as yet, that the only deleterious effect which the air of crowded barracks or tenement-house rooms, or of foul courts and narrow streets, exerts upon the persons who breathe it, is due to the greater number of pathogenic micro-organisms in such localities. It is quite possible that such impure atmospheres may affect the vitality and the bacterioidal powers of the cells and fluids of the upper air-passages with which they come in contact, and may thus predispose to infections, the potential causes of which are almost everywhere present, and especially in the upper air-passages and in the alimentary canal of even the healthiest persons, but of this we have as yet no scientific evidence. It is very desirable that researches should be made on this point.

X. The discomfort produced by crowded, ill-ventilated rooms, in persons not accustomed to them, is not due to the excess of carbonic acid, nor to bacteria, nor, in most cases, to dusts of any kind. The two great causes of such discomfort, though not the only ones, are excessive temperature and unpleasant odors. Such rooms as those referred to are generally overheated, the bodies of the occupants and, at night, the usual means of illumination contributing to this result.

The cause of the unpleasant, musty odor which is perceptible to most persons on passing from the outer air into a crowded, unventilated room is unknown; it may, in part, be due to volatile products of decomposition contained in the expired air of persons having decayed teeth, foul mouths, or certain disorders of the digestive apparatus, and it is due, in part, to volatile fatty acids given off with, or produced from, the excretions of the skin, and from clothing soiled with such excretions. It may produce nausea and other disagreeable sensations in specially susceptible persons, but most men soon become accustomed to it, and cease to notice

it, as they will do with regard to the odor of a smoking-car, or of a soap factory, after they have been for some time in the place. The direct and indirect effects of odors of various kinds upon the comfort, and perhaps also upon the health of men, are more considerable than would be indicated by any tests now known for determining the nature and quantity of the matters which give rise to them. The remarks of Renk (38, p. 174) upon this point merit consideration. Cases of fainting in crowded rooms usually occur in women, and are connected with defective respiratory action due to tight lacing or other causes.

Other causes of discomfort in rooms heated by furnaces or by steam are excessive dryness of the air, and the presence of small quantities of carbonic oxide, of illuminating gas, or of arsenic derived from the coal used for heating.

XI. The results of this investigation, taken in connection with the results of other recent researches summarized in this report, indicate that some of the theories upon which modern systems of ventilation are based, are either without foundation or doubtful, and that the problem of securing comfort and health in inhabited rooms requires the consideration of the best methods of preventing or disposing of dusts of various kinds, of properly regulating temperature and moisture, and of preventing the entrance of poisonous gases like carbonic oxide, derived from heating and lighting apparatus, rather than upon simply diluting the air to a certain standard of proportion of carbonic acid present.

It would be very unwise to conclude from the facts given in this report, that the standards of air-supply for the ventilation of inhabited rooms, which standards are now generally accepted by sanitarians as the result of the work of Pettenkofer, De Chaumont and others, are much too large under any circumstances, or that the differences in health and vigor between those who spend the greater part of their lives in the open air of the country hills, and those who live in the city slums, do not depend in any way upon the differences between the atmospheres of the two localities except as regards the number and character of micro-organisms.

Possible Advances in the Weather Service.— The following paragraphs are taken from an Address by Mr. John R. Sage, Director of the Iowa Weather Service, before the Iowa Horticultural Society, Dec. 12, 1895, and published in the December *Bulletin of the Iowa Weather and Crop Service.*

"The weather has been the subject of daily observation and remark in all ages, yet the science which undertakes by rational and philosophical methods to account for the varied phenomena of the atmosphere is comparatively new. And by far the greater portion of all that has been achieved in the solution of the intricate problems relating to the weather has been wrought out within the latter half of the nineteenth century. The weather service, established by the government, with its corps of trained observers and scientific professors, has been the chief agency by which this has been accomplished. But none so well realize how narrow is the range of present knowledge, and the vastness of the unknown, as the pioneer investigators and zealous students who have attempted to blaze a way across the unexplored realm.

"The Weather Bureau, including the State branches, was instituted to serve the people, and to do this efficiently it must be progressive. And the advances that are not only possible, but also most desirable, should be along educational and practical lines.

"There is need of popularizing the science of meteorology, and more widely disseminating a knowledge of the salient facts that have been learned in this new field of investigation. Whatever of truth has been acquired is needed to displace error, and to drive out the whole brood of traditions and superstitions transmitted from the mediæval ages. Large numbers of people regard the science relating to the weather as belonging to the realm of the occult, and the laws that control the elements are supposed to be beyond the ken of ordinary mortals.

"This gives opportunity for the practice of deception by all sorts of fakirs, charlatans, and astrological weather prophets. When the people have acquired a knowledge of even the elementary principles of the weather science, these pretenders will not find profitable employment, and their long-range predictions and abstruse calculations of planetary or lunar influences will have no more currency than last year's almanacs.

"The special need of this age is science made popular and more widely disseminated. And to this end there is need of workers and students in this field who are in close touch with the common people; who are able to translate the most scholarly and profound scientific writings into the language of ordinary people. The scientific lore of this age cannot be shut up in cloisters, nor monopolized by favored classes, but must be scattered broadcast to take root and bear fruitage in the world.

"And I am glad to make note of the fact that the Weather Service is doing excellent work along the line of popular education. In the higher institutions of learning the science of meteorology is receiving a larger share of attention, and the masses of the people are being reached through the magazines and newspapers. And in the near future all who make any claim to a liberal education will have acquired knowledge of the essential principles of this science.

"Especially in connection with the study of horticulture and agriculture, considerable attention to meteorology and climatology is essential. For these are closely correlated sciences. In practical horticulture success depends absolutely upon adaptation of plant or tree to the climate. And the weather service should furnish the necessary data for the study of the effects of climate upon all classes of vegetation.

"Here is where the educational and economic lines converge, and the purely scientific or theoretical becomes practical. Horticulture in the practical field is applied science; the botanist, meteorologist, geologist, entomologist and chemist contributing their quota to its complete success. . . .

"For the advancement of both horticulture and the Weather Service, a more close and intimate relation should be established between them. Every man engaged in practical horticulture, as his chief vocation, should be a thorough meteorological observer, with a full equipment of the best scientific instruments to be obtained. He should make records of daily

observations of the temperature of the air, rainfall, humidity, atmospheric pressure, soil temperature, etc. And he should make frequent observations of soil moisture, taking due note of the final disposal of rainfall to determine whether it is flowing away in streams or is being mainly absorbed by the soil and sub-soil to be available for plant growth in time of shortage. In fact, the live, progressive, and successful horticulturist should maintain a weather service of his own, enlarging its scope to take in all the matters that relate to his special work.

"When the horticulturist is fully equipped and trained as a meteorologist, he should then join the corps of voluntary observers connected with the State and National Weather Service, thereby adding his quota to the general fund of knowledge for the benefit of the public.

"That is the way the Weather Service is being built up, extended and improved — by voluntary co-operation of skilled observers. In this bureau there are but few 'drawers of salaries'; the most of them must work for nothing and 'find themselves.' A vast deal of this wholly gratuitous work must be done in order to furnish sufficient data to serve as the basis of scientific deductions of practical value to all the people. But, after all, those who serve the public thus gratuitously are recipients of direct benefit in the form of scientific knowledge, and the satisfaction resulting from serving their State and nation.

"There is a vast deal yet to be learned in relation to the climate of this mid-continent region. We have barely begun to study systematically all the phases of the weather, the extremes of temperature, the variability of rainfall, the recurrence of drought periods, the capacity of different soils for the storage of water, the best means of conserving moisture, and the many questions relating to the economic effects of surface or tile drainage, subsoiling, etc. The weather service has entered upon these lines of investigation, and in this work it is desired to secure the co-operation of all thoughtful, capable, and practical men in the country. We want your help to solve some problems in relation to the economic value of shelter belts, groves, and hedges, and their proper location; the best means of preventing soil washing, and the benefit to be derived from storage of water in artificial lakes and ponds. These must be solved by experience, and only practical men are in a position to make the necessary tests and observations.

"The matter of irrigation is being discussed as both desirable and possible, even in the regions eastward of the Missouri. We may find it profitable, if not absolutely necessary, to draw water from subterranean reservoirs to irrigate gardens and orchards in the occasional periods of extreme drought. This is a question worthy of the consideration of those who make note of the fact that by more extensive cultivation and the production of our immense crops we are lowering the water level and making much heavier drafts upon the supply of moisture furnished by our average rainfall. We must either manage to keep a larger portion of our seasonal rains from going to waste by running off in the streams and by evaporation from sun and wind, or we must bore to the lower depths and draw it up to supply our largely increased demands.

"We are just beginning to study some elementary lessons in the costly

school of experience, to learn how to retain our vast patrimony of soil fertility and how to handle the rainfall so as to dispose of the surplus and provide for the storage of moisture for occasional seasons of deficiency. The tendency of the climates of all mid-continent regions is toward extremes. The means may be constant through long periods, but the wide departures and sharp reactions are the special features of the climate that test the hardy qualities and vitality of all forms of animal and plant life.

"Though we have a general uniformity of climate, yet we may note marked variations in different localities, as shown by the effects upon certain varieties of plants and fruits. The reports made by nurserymen and experimenters, in contiguous districts, in the same latitude and altitude, show marked differences in growth, vitality, hardiness, and other qualities of the same varieties of fruits and plants.

"How shall we account for these divergences? In my opinion the climate is sometimes charged with responsibility that does not belong to it. Methods of planting, quality of soil and sub-soil, exposure to sunshine and hot winds, location with reference to shelter belts or ridges, and other purely local conditions, are all important factors to be considered in the solution of this problem. Here is a great field for study and advancement.

"For the complete presentation of this subject a volume would be required. And within the limits of this brief paper I have only attempted to suggest some of the possibilities of advancement in this branch of the public service, along these economic and educational lines. To make this service most valuable to the public there is required the active co-operation of a large number of intelligent observers. Large masses of facts and figures should be collected and tabulated, and experts should give them careful study to find out what they mean. There is mighty little in any of the books to help us in the solution of the many intricate problems that perplex us. We must closely study the facts and question nature. The text-books of meteorological science are mainly in the fields, groves, forests, and on the mountain tops. All the elements are vocal with instruction, and the revolving old earth, and the great dome of sky above, are thicky set with object lessons for our study."

Royal Meteorological Society. — The monthly meeting of this Society was held on Wednesday evening, Feb. 19, at the Institution of Civil Engineers, Westminster, Mr. Edward Mawley, F. R. H. S., President in the chair.

The Report on the Phenological Observations for 1895 was presented by Mr. Mawley, in which it was shown that owing to the great frost at the beginning of the year, all the first spring flowers made their appearance very late; and it was not until the middle of June that plants began to come into blossom in advance of their usual time. During July the dates recorded were, as a rule, exceptionally early. The yield of all the farm crops, except potatoes, was exceedingly poor. Pears and plums yielded badly, but there was a splendid crop of apples and also of all the small fruits. As regards vegetation generally, seldom has a year ended under conditions as favorable for the one succeeding it.

Mr. R. H. Scott, F. R. S., read a paper on the recent unusually high barometer readings in the British Isles, in which he stated that the Daily

Weather Chart for 6 P. M. on Jan. 8, was the first in these islands that ever showed 31 inches. The station was Stornoway, and by the next morning all over the northern portions of Great Britain and Ireland the barometers were above 31 inches. The highest reading of all was 31.119 ins. photographically recorded at Glasgow at 9 A. M. on the 9th. The barometric pressure then gave way, and the region of highest readings moved southwards along our west coast, and finally left the south of Ireland on the 15th. Weather throughout the period was mild, an unusual thing with a very high barometer. At the end of the month a second anticyclone spread over the country, when the barometer rose to 30.96 ins. at Cork. Reference was made to previous excessively high barometer readings in England and in Siberia, and it was stated that a reading of 31.62 ins. at Barnaoul in Siberia, in 1877, was probably the highest ever observed.

Mr. R. Inwards, F. R. A. S., read a paper on "Turner's Representations of Lightning," which he considered to be true to nature, and demonstrated the same by placing an actual example of Turner's work side by side with a photograph of a real flash of lightning.

The International Cloud Year. — By this is meant the simultaneous series of observations of heights, directions, and velocities of clouds, which, by recommendation of the Upsala meeting of the International Meteorological Committee, will be carried on in various parts of the world for one year, commencing the first of May of this year.

Nine countries have promised to take part in this scheme, and measurements of the altitudes of clouds will be made at one or two stations in each country, while their directions of motion and relative velocities will be observed at a larger number of stations. For the first-named work, photographic theodolites (photogrammeters) will probably be employed except in the United States. The Weather Bureau at its central station in Washington will follow the methods practised at Blue Hill in 1890–1, but instead of the specially constructed visual cloud theodolites it will use modified surveyors' transits. At Blue Hill the previous methods will be employed with the addition of a longer base (1 1–2 mile) for the measurement of high clouds. In observing the directions of motion and relative velocities of clouds by the use of nephoscopes, the Blue Hill Observatory will co-operate with the Weather Bureau whose stations will be Washington, New York, Buffalo, and Detroit. These stations should give a good measure of the circulation of the upper air in every high and low area passing near the usual storm track. Some voluntary observers may, perhaps, be induced to make these nephoscope observations, since the instrument is simple and easily used. The discussion of this mass of data from all parts of the world will certainly elucidate both the general and restricted movements of the atmosphere, produced by widespread and relatively permanent, and by local and transient, disturbances, and so practically improve our weather forecasts.

A. L. R.

New England Meteorological Society. — A special meeting of the Council of the New England Meteorological Society was held in Boston at the call of the President, Prof. W. H. Niles, on Feb. 29, 1896, to consider the future

of the Society, in view of the announced cessation of the AMERICAN METEOROLOGICAL JOURNAL with the April number. Since the system of meteorological observations in New England and the publication of a monthly Bulletin were transferred to the New England Weather Service several years ago, the chief service of the Society, apart from its meetings, has been in the assistance it gave to the AMERICAN METEOROLOGICAL JOURNAL, by subscribing for it for all regular members. Now that the JOURNAL is to be discontinued by reason of insufficient support, the meetings of the Society, attended by only a few of its small number of members, seem a hardly sufficient object to warrant the continuance of the organization. The Council therefore voted to recommend that the Society be dissolved at the end of the present Society year; and that action upon this recommendation be taken at the regular meeting to be held April 18, 1896.

Special notice of this vote will be duly sent to all members of the Society. In the meantime, this brief announcement will serve to bring the question forward for consideration.

W. M. DAVIS, *Secretary, N. E. Met. Soc.*

MARCH 3, 1896.

The Meteorological Use of Kites at Blue Hill.—For eighteen months past, experiments have been in progress at Blue Hill Observatory with kites as a means of elevating meteorological instruments. Important improvements have recently been effected in the apparatus and the methods employed. Both the tailless, or Eddy, and the cellular, or Hargrave, kites, covered generally with varnished cloth, are flown in winds varying from twelve to thirty-five miles an hour, and even in rain and snow storms. Pianoforte wire has been substituted for cord which a strong windlass mounted on wheels serves to manipulate, and although vertical heights of two thousand feet have not yet been attained, it is confidently expected that this will now be exceeded. The meteorograph constructed by Mr. S. P. Fergusson of the Observatory, which is carried by the kites, weighs only two and one-half pounds, and records continuously the temperature and humidity of the air and the velocity of the wind. A somewhat similar apparatus, recently received from Richard Brothers in Paris, is called a baro-thermo-hygrograph from the instruments which it contains (see illustrated description in *La Nature*, Feb. 8, 1896). "Soundings" of the atmosphere to the height of a quarter of a mile have been made the past winter every day or two, and important data have already been obtained. A discussion of the past and the subsequent observations promises to contribute materially to our knowledge of the free atmosphere under varying conditions. At the April meeting of the New England Meteorological Society it is expected that the Blue Hill experiments will be described and the apparatus shown.

A. L. R.

CORRESPONDENCE.

METEOROLOGIGAL OBSERVATORIES A NECESSITY IN MODERN CITIES.

Editor of the American Meteorological Journal:

The functions of a well-equipped meteorological observatory are manifold. The necessity for a national weather bureau has become a settled fact. The time has arrived for an enlargement of the work at first undertaken by the Government of the United States. Most of the States co-operate with the National Bureau through so called "voluntary" observers. It is my purpose to show that the services of such observers are of such importance at the present time that meteorologists of renown should devote more attention to this grade of work.

It will not be long before every city in the Union will have a thoroughly equipped meteorological observatory. A new field is to be opened for students. Allow me to present a few considerations, as the result of four years' work as a "voluntary observer" and "signal man." Of all the problems that have been forced upon me, the most difficult has been to properly conduct my observations without interfering with my duties as instructor in a High School. My labors in the former occupation have increased year by year. One of the most trying situations is that of weather "sharp" who shall be ready at all times to supply data for the press; another, that of serving as expert witness in suits at the Court House. Four observations daily are taken at the school, and of these three are entered upon our books (the fourth being special service at noon for a local newspaper). We have maximum and minimum thermometers, wet bulb and dry bulb thermometers, a self-registering thermometer, a wind wave, a self-recording anemometer, and the rain gauge.

It was reasonable to expect visits from newspaper men. In fact, our reporters have grown to be generous in their dealings with us, never doubting the accuracy of our reports, and at times showing a willingness to assist financially the work of the observatory.

A more serious difficulty arose when subpœnas appeared from court officials, summoning us to testify concerning the weather on certain days. That a teacher can at any time leave his class-room, and transfer his presence to the "halls of justice," no reasonable person could expect. And it is no more than just for me to state here that on several occasions the presiding court officer has been lenient. On counsel's request, too, witnesses then testifying at the moment of our entry have been excused in order to save us

time. On some other occasions, counsel have been persuaded, with difficulty, perhaps, to postpone the "weatherman's" appearance till after school hours.

Some of the trials that have required our presence are as follows: The first was a murder case, where the murderer, at midnight, took his victim a number of miles from the heart of the city, and brought him to a distant meadow, testimony being required because witnesses who were endeavoring to prove an alibi for the prisoner gave conflicting accounts of the weather. Then followed three or four cases in which a railroad company was sued for damages, in one of which a railroad platform and stair were not lighted late on a cloudy afternoon in winter, the railroad people claiming that the day was clear. In another case I was called by the defence in a suit against a traction company which had put off a passenger and forced him to walk four miles while in poor physical condition. In this case the claim set up by plaintiff was that he had to walk home in the rain, whereas really there had been no rain. Had the defence been shrewd, it could have scored a point by showing that the temperature at the time was 90°. Again, a summons called us in a suit for damages brought by a person who had been injured by falling downstairs in a poorly lighted hallway. In this case the testimony was of little avail. Our observation at 2 P. M. showed a clear sky; at 9 P. M. a sky overcast, with rain at 9.30. The accident occurred at 5.15. If the sky was clear the hall was sufficiently light until after six, at that time of year.

The anemometer has been of service in two suits, both times for defendant. There were unusually high winds, seventy miles an hour, which made structures fall and hurt passers-by. Such cases show how one great need is supplied in our city. Occasions when information was sought by men engaged in manufacturing and in mercantile pursuits were quite numerous. A certain large retail house in the city found its receipts for a certain month unusually low. It was not noticed by the head of the firm until the year had closed and a summary was being made. An application to the observatory brought out the information that was needed. The month had been an unusually stormy one.

Another case I remember was that of a manufacturing establishment whose product is materially affected by a damp atmosphere. We were requested to furnish statistics of humidity for certain days, when, I presume, there had been some serious falling off in the character of the goods turned out. We have given advice to ice men, who were hesitating to begin the work of cutting.

The Board of Health of the city secures a weekly summary for its report on mortality and vital statistics; also a monthly record. The monthly records appear in the Annual Report of the Board. That the information is of some value is made apparent by the fact that such service is paid for.

These facts are presented here to show the varied features of a moderately well equipped meteorological observatory in a city of fair size. The work has developed to such an extent that it is a severe tax upon the time and pocket of the teacher who began the undertaking from pure love of nature study. My experience teaches me that there should be hourly observations

throughout the day, and at least three every night, from nine to the next morning.

The condition of the sky as to cloudiness should be most carefully noted; the actual time of precipitation; the moments of heavy precipitation; the direction of the wind and its velocity are of supreme moment. My testimony was once required in a case where suit was brought by friends of a man who was killed while walking upon a railroad track. Their claim was that there had been no warning whistle or bell ringing. The engineer testified that he used every measure in his power to warn the approaching person. The observations showed that an exceedingly high wind was blowing at the time, and *toward* the locomotive; the engineer was freed from blame.

Such a bureau should be under the charge of an educated man, preferably an instructor of science in a high grade school. He should have the power of choosing an assistant or two, who are to serve for a fair consideration, but whose attainments need not far exceed the ability to read accurately all instruments in the establishment. The instructor meets many pupils. They come from all parts of the city. Information should be brought of showers in each locality. The date of first appearance of ice on watered sidewalks in a city is of more value than the date of first frost. The earliest ice in ponds within city limits, the damage done to trees and dwellings during high winds, flooding of streets, sewers, and cellars, etc., — all should have their place in the records of a city. Many of these facts prove of value at some time and at some place. I have been consulted to account for flooding of certain cellars in a low section of the city near the river front, and found it due to excessive high tides in the neighboring stream. The Water Board of the city government have applied at times for information concerning rainfall.

Enough has been shown to establish the point aimed at, that meteorological bureaus should be established and maintained in all large cities for the benefit of the public, and, it may be added, at public expense.

Arguments for and against the management of such bureaus by an educator in some academy or high school have also been presented. In regard to testifying in court, objections might vanish if the clerk of the weather were allowed to present his record, together with an affidavit, or if his testifying could be given after school hours, or, if absolutely necessary for him to appear in court during the session of his school, by making it possible for him to testify at once.

Geo. C. Sonn.

Public High School, Newark, N. J., Jan. 11, 1896.

BIBLIOGRAPHICAL NOTES.

BLUE HILL OBSERVATORY OBSERVATIONS FOR 1894.

Observations made at the Blue Hill Observatory, Massachusetts, U. S. A., in the year 1894. Under the Direction of A. Lawrence Rotch, A. M. With an Appendix containing *Anemometer Comparisons.* Annals of the Astronomical Observatory of Harvard College, Edward C. Pickering, Director. Vol. XL. Part IV., Cambridge, 1895, Pp. 211–299, Pls. II., and Frontispiece.

In our review of the Blue Hill Observatory observations for 1893 (see this JOURNAL, Vol. XI., 1894–5, p. 457), we referred to the fact that the Metropolitan Park Commission had taken Blue Hill into the Metropolitan Park System, and expressed the hope that some arrangement might be made by which the environment of Mr. Rotch's observatory might be retained as it is at present. Regarding this very important matter, Mr. Rotch says in his introduction to the present volume, "The environment of the Observatory has undergone no change since the creation of the Reservation by the Commonwealth, but the future existence of the Observatory and its immunity from encroachment cannot be assured until the lease from the Metropolitan Park Commission, proposed in last year's Introduction, is consummated." We can but repeat our earnest wish that this arrangement may be completed at once, in order that all those who are interested in the work of the Blue Hill Observatory may feel at ease regarding its future.

During the year Messrs. Clayton, S. P. and W. H. Fergusson have had charge of the investigations, instruments, and observations. Mr. Clayton has continued his study of the movements of the upper air, as shown by clouds, around cyclones and anticyclones, and has now completed the investigation. A few of the results he has obtained were published in his paper on "Relation of Clouds to Rainfall" in the August, 1895, number of this JOURNAL, pp. 110–116. The full report will shortly appear in the Annals of the Astronomical Observatory of Harvard College. Mr. Clayton has further continued his studies of weather periodicities, and made practical use of his results in the issue of the *Blue Hill Weekly Weather Bulletin*, reference to which was made in this JOURNAL for September, 1894, p. 197. Mr. S. P. Fergusson, who has been carrying on an extended series of anemometer comparisons since 1892, has completed his work, and his results are published as an appendix to the present volume. Mr. W. H. Fergusson has taken a large number of cloud photographs, and his view of "Trade Cumulus" has been selected for publication in the International Cloud Atlas.

During the year 1894 Mr. Rotch, as is known to the readers of this

Journal, attended the meeting of the International Meteorological Committee at Upsala, he being a member of the International Cloud Committee, which held a meeting at the same place and time. During August, 1894, Mr. W. A. Eddy, of Bayonne, N. J., experimented at Blue Hill Observatory with tailless kites, Mr. S. P. Fergusson constructing a special thermograph, weighing only one pound eight ounces, for use with these kites; the results obtained through these experiments have been set forth by Mr. Clayton in this Journal for December, 1894, pp. 297–303 ("Meteorological Records obtained in the Upper Air by Means of Kites").

The foregoing list of different lines of work followed out at Blue Hill by its observers shows that the year 1894 was not allowed to pass by without much study and careful observation. Every year certainly puts meteorologists under an increasing debt of gratitude to Mr. Rotch for his liberality in maintaining his observatory.

The volume for 1894 contains the usual complete tables of observations and Mr. Fergusson's report on *Anemometer Comparisons*. The latter is very carefully prepared, well illustrated, and contains a bibliography. It cannot fail to be of great value to all those who are interested in instrumental meteorology.

The frontispiece of this volume presents a view of the observatory from the southeast, as well as one of the different types of anemometers compared by Mr. Fergusson.

REPORT OF THE CHIEF OF THE WEATHER BUREAU.

Willis L. Moore. *Report of the Chief of the Weather Bureau for 1895.* From the Report of the Secretary of Agriculture. 8vo. Washington, 1895, 65–96.

Prof. Willis L. Moore's first Report as Chief of the Weather Bureau is a publication of more than usual interest. Special emphasis is laid on the forecasts, and extracts from newspapers are quoted, showing the great value of the different warnings issued. The estimated value of property saved by cold wave warnings alone was $2,275,000, and we think Prof. Moore is well within the limits of accuracy when he says that $10,000,000 is probably a conservative estimate of the amount saved. During two tropical cyclones in September and October, 1894, 10,305 vessels, valued at $36,283,000 remained in port as a result of the Bureau's warnings, and in many instances the owners have stated that, but for the warnings, the vessels and cargoes would have been total losses.

A new "hurricane signal" was adopted during the year, and the co-operation of the Customs, the Life-Saving, the Light-house and the Revenue Cutter Services was secured in the dissemination of these warnings. Arrangements have been made for the receipt of meteorological reports from Merida, Yucatan, whenever there are signs of hurricane formation in that vicinity.

The number of daily weather maps issued during the year was 3,148,895 from seventy-four stations, an increase of 241,115 in the number of maps and of two in the number of issuing stations as compared with the previous

year. We are glad to note the following: "At the larger stations the number of maps that can be printed at a single issue by the present method has nearly reached its limit, and effort is being made to devise a means of printing a larger edition. The present milliographic method is not entirely satisfactory. Experiments are now being made with the view of devising a more economical method, one that will ensure a more legible print and more lucidly present the weather conditions to the public." We have long thought that many of the local weather maps are by no means a credit to the Weather Bureau, by reason of the poor quality of paper, and the faint lines and figures, and therefore welcome the announcement that we are soon to have something better. We most sincerely hope, however, that the Washington lithographic map will not be discontinued, and that provision will be made for a wide distribution of the Washington maps to the schools, where they furnish such admirable illustrations for the children who are studying meteorology. The new maps, which we are informed are to be much smaller than the present ones, will be too small to be used as illustrations before a class. It is therefore highly desirable to have an abundant supply of the Washington lithographed maps for this purpose.

A clear summary is given of the work of the Bureau, the change in the old and the addition of new publications; the improved cotton region service; a proposed wheat and corn service; the addition of sensible temperatures to the regular daily meteorological records; the proposed upper air observations, etc. Evidently our Weather Bureau continues at a high standard of efficiency.

CLOUDS AND WEATHER.

D. WILSON-BARKER, F. R. S. E., F. R. MET. SOC. *Clouds and Weather. A Study for Navigators.* 8vo. London, "The Shipping World" Office, 1895. Pp. 21. Twenty-five Cloud Views from photographs taken by the author. Figs. 2. Price sixpence.

We are glad to call attention to this pleasing little pamphlet by Capt. Wilson-Barker, entitled "Clouds and Weather." The author has made a careful study of clouds for some years, and has taken many excellent cloud photographs, and being himself a seaman, is well fitted to prepare such a paper for the use of navigators. As is probably known to some of our readers, Capt. Wilson-Barker proposes to have only two types of clouds, *cumulus* and *stratus*, all other forms he considers only varieties of these two principal types. Under *cumulus* he puts five varieties: Fine weather cumulus; *roll cumulus; squall cumulus; pillar cumulus*, noticed by the author only about the calm belts of the ocean, and *shower cumulus*. Under *stratus* there are also five varieties: *Fog, true stratus, high stratus, cirrus*, and *scud.*

The illustrations are on a small scale, and suffer a good deal in consequence. Some of them, however, are very good, especially No. 19, showing waves of cirrus. To judge by this reproduction we think the original photograph must be the best one of this particular type that we know of.

We are sorry that navigators should have any cloud classification other than that adopted by the International Meteorological Conference suggested

to them, as it is in the highest degree desirable that everyone should use one classification as far as possible. This pamphlet will, however, do good if it impresses seamen with the importance of accurate cloud observations, and with the close relation between clouds and weather. The price of the paper is only sixpence, so that it should have a large sale. It may be procured from "The Shipping World" Office, Effingham House, Arundel Street, London, W. C.

THE GUINEA AND EQUATORIAL CURRENTS.

KONINKLIJK NEDERLANDSCH METEOROLOGISCH INSTITUUT. *De Guinea en Equatorial Stroomen.* Utrecht, 1895. 14 x 23 inches. 4 pp. 24 charts. Price 8f. 50.

The Royal Meteorological Institute of the Netherlands adds another valuable publication to its list of works and charts already issued in connection with maritime meteorology. The present one, which has recently appeared, deals with the Guinea and Equatorial Currents, and was prepared under the direction of M. P. F. van Heerdt, the able Director of the Maritime Section of the Institute.

The data on which the charts in this atlas are based were furnished by Dutch ships. There are five charts for each month. The first, a large one shows all the observations of currents which were obtained, collected together in one degree squares, besides a tabular statement as to the number of days of observations of currents and other current data, together with wind and other meteorological observations. The four smaller charts for each month show respectively, I., a summary of the large chart, just referred to, in which the Guinea current is distinctly brought out; II., the mean currents in the four quadrants, calculated from the arithmetical means of velocity of all the currents observed in each quadrant, together with the sea surface isotherms; III., isotherms of air temperature; and IV., wind observations shown by means of wind roses, in five-degree squares, with the mean velocity of each wind, and other data.

The area covered by the charts extends up to 24° N. Lat. In order to bring out the Guinea Current more distinctly, black arrows are used to indicate the eastward flowing, and red arrows the westward flowing currents. The wealth of material in this admirable set of charts is difficult to overestimate. Data as to precipitation, temperature of air and water, earthquakes, wind direction and velocity, calms, storm waves, appearance of flying fish, phosphorescence, discoloration of the ocean water, etc., are included in this publication, which certainly reflects the highest credit on M. van Heerdt and all who have contributed to this work under his direction. The Meteorological Institute of the Netherlands is certainly doing a great work for meteorology.

The price of the atlas is only 8f. 50, and it may be procured from H. G. Bom, Warmoesstraat 35, Amsterdam.

INDIAN METEOROLOGICAL MEMOIRS.

JOHN ELIOT, M. A., F. R. S. *A Preliminary Discussion of Certain Oscillatory Changes of Pressure of Long Period and of Short Period in India.* Indian Meteorological Memoirs. Vol. VI. Part IV. Fol. Calcutta, 1895. Pages 89–160. Vols. XX–XXV.

This report, by Mr. John Eliot, Meteorological Reporter to the Government of India, is divided into two parts. In the first, data are given showing that the normal pressure conditions in India are very broadly marked, the ordinary seasonal changes proceeding with remarkable regularity and uniformity. The abnormal pressure conditions, associated with the larger seasonal variations or the occurrence of storms, are usually but slightly marked. In the second part certain oscillations of long and short period are considered, which differ from the annual and diurnal oscillations, and are characterized by a greater amount of (apparent) irregularity than these two periodic pressure changes. These oscillations are of great importance, because they are probably associated with atmospheric movements common to the whole of Southern Asia and the adjacent seas.

JOHN ELIOT, M. A., F. R. S. *The Discussion of Hourly Observations made at Chittagong.* Indian Meteorological Memoirs. Vol. IX. Part I. Fol. Calcutta, 1895. Pp. 1–32. Plates VI.

This volume of the Indian Meteorological Memoirs continues the series of parts which are devoted to "the diurnal variation of atmospheric conditions in India, being a discussion of the hourly observations recorded at twenty-five stations since 1873." The data thus published from time to time are of great value, and it is with pleasure that we receive these Indian reports, one after another, ever-recurring reminders of the activity of the Indian Weather Service. Chittagong, for which the observations are given in the present volume, is situated in the extreme northeast corner of the Bay of Bengal, in nearly the same latitude as Calcutta, on the coast of the Arakan mainland.

PROCEEDINGS OF THE ANTWERP METEOROLOGICAL CONGRESS.

Congrès de l'Atmosphère. 1894. *Compte rendu par le Chevalier Le Clément de Saint Marcq.* Anvers. 1895. 8vo. 272 pp.

This congress, of which mention was made in Vol. XI., pages 237 and 268, was held at Antwerp in connection with the International Exposition of 1894. Owing to the session of the International Meteorological Committee at Upsala and to other causes, there were few meteorologists present. From among the two or three foreigners, Messrs. Hepites and Rotch, *en route* to Upsala, were chosen honorary presidents at the first day's session of the first section devoted to aerial currents. The second section, which treated of aerodynamics, had few papers presented to it. Apart from

the two presidential addresses on aerial navigation, the most important communications made to the congress were by M. Plumandon, of the Puy de Dôme Observatory, on the variation of wind velocity with altitude, and the geographic position of the station, by M. Lancaster on synoptic weather charts and elaborate papers by the same author on the force and velocity of the wind in Belgium (see this JOURNAL, Vol. XII., p. 364). M. Ventosa. of the Madrid Observatory, communicated his later researches on the determination of the direction of the upper currents by means of the undulations observed on the limbs of stars (a method used by Mr. A. E. Douglass in this country, and described in this JOURNAL, Vol. XI., No. 11), and M. Durand-Gréville, of Paris, sent a memoir on wind in squalls which was reviewed in No. 9 of this volume. These and other papers are printed *in extenso*, and the volume is closed with a valuable bibliography of aerial navigation from the earliest times to the present by Lieut.-Gen. A. Wouvermans. A. L. R.

THE WINTER STORMS ON THE COAST OF CHINA.

S. CHEVALIER, S. J. *Essay on the Winter Storms on the Coast of China.* Third Annual Report of the Shanghai Meteorological Society for the year 1894. 8vo. Shanghai, 1895, pp. 48, plates III.

Father Chevalier's *Essay on the Winter Storms on the Coast of China* forms the third annual report of the Shanghai Meteorological Society, a very energetic body certainly, if we may judge from its yearly publications, and one which, through its able president, is issuing much valuable information regarding the meteorology of China.

The divisions of the present paper are as follows: general definition of a winter storm; place of origin; trajectory of the cyclones; the level and intensity of our extra-tropical cyclones; general features of the weather occasioned on the China coast by extra-tropical cyclones. There are three plates, showing the mean isobars for January, March, and October.

ANNALS OF THE ROUMANIAN METEOROLOGICAL INSTITUTE.

STEFAN C. HEPITES. *Analele Institului Meteorologic al Romaniei.* Tomul x. Anul 1894. 4to. Bucharest and Paris, 1895. Pp. x; A1–A33. B1–B70; C338; D331.

M. Hepites sends us his annual volume of *Annals*, replete with interesting information about his meteorological work in Roumania. The present is the tenth volume, the Roumanian Meteorological Institute having been organized in 1884, after the death of a great benefactor of Roumania, Vassile Paapa, who left the sum of fifty thousand francs to be used in creating a meteorological observatory. M. Paapa's portrait most fittingly appears as a frontispiece to this volume, and M. Hepites alludes to him in very appreciative terms in the introduction. The *Annals* contain the usual report to the Minister of Agriculture, memoirs on the climatology of 1894, the organization of the Royal Meteorological Institute in Berlin, and on the

Rainfall of 1894; the hourly observations at Bucharest; the observations made at the different stations throughout the country.

It is certainly to be regretted that M. Paapa could not have seen the admirable organization which Director Hepites has built up, and which is doing such active, intelligent, and well-directed work.

ANNUAL REPORT OF THE MICHIGAN STATE BOARD OF HEALTH.

Twenty-first Annual Report of the Secretary of the State Board of Health of the State of Michigan for the Fiscal Year ending June 30, 1893. 8vo. Lansing, 1895. Pp. 444, with maps, charts, and diagrams.

The Annual Report issued by Dr. Henry B. Baker, of the Michigan State Board of Health, is a perfect mine of information for the student of that intensely interesting subject, medical climatology. If we mistake not, the Michigan Board of Health is doing far more work in this line than any other similar body in the country, and its report presents every year a most instructive set of charts showing the relation between the prevalence of and the mortality from different diseases and meteorological conditions. Other States should follow the example set by Michigan.

WEATHER RECORD FOR THE HAWAIIAN ISLANDS.

CURTIS J. LYONS. *Weather Record for Honolulu and the Hawaiian Islands*, 1893. 8vo. Hawaiian Weather Bureau, Honolulu, 1895. Pp. 48.

Mr. Curtis J. Lyons kindly sends us his Annual Report for Honolulu and the Hawaiian Islands. The report contains full tables of the regular meteorological data recorded at Honolulu, and monthly rainfall tables based on observations made at thirty-one rain gauge stations on the different islands of the group.

INVESTIGATIONS OF THE HURRICANES OF THE ANTILLES.

BENITO VIÑES, S. J. *Investigaciones Relativas a la Circulacion y Translacion Ciclonica en los Huracanes de las Antillas.* 8vo. Habana, 1895. Pp. 79.

The memoir on the Hurricanes of the Antilles, which has recently come to hand, was prepared by the late Padre Benito Viñes, for the Chicago Meteorological Congress of 1893. It is issued by the Royal Observatory of Belen, in Havana, in neat and attractive form, preceded by an appreciative notice of Padra Viñes and of his valuable work for meteorology. Padre Viñes' previous writings on the West Indian hurricanes had long since given him a high rank among the meteorologists of the world, and the present paper is a further important contribution to the same subject.

Meteorology lost one of its most careful and most enthusiastic workers when death claimed Padre Viñes.

THE TYPHOONS OF 1894 AT MANILA.

JOSÉ ALGUÉ, S. J. *Baguios ó Tifones de* 1894. *Estudio de los Mismos seguido de Algunas Consideraciones Generales acerca de los Caracteres de estos Meteoros en el Extremo Oriente.* 4to. Manila, 1895. Pp. 180. Many Figures and Charts.

Father José Algué, Sub-Director of the Manila Observatory, has prepared a most important memoir on the typhoons of 1894, accompanied by some general considerations on the character of these disturbances in the far East. The first part of the report contains an account of the storms which were noted in 1894, and the second takes up the origin, structure, progression, trajectories, and classification of typhoons in general. A large number of charts accompany the memoir, showing paths, barometric curves, isobaric lines, zones of origin, etc.

PRECIPITATION AND THE FLOW OF RIVERS IN TEXAS.

ISAAC M. CLINE, M. A., M. D. *Precipitation and the Flow of Rivers in Texas, considered in Relation to the Question of Irrigation.* Texas Weather Service. Special Bulletin No. 7, issued in Co-operation with the Galveston Cotton Exchange. 8vo. Galveston, 1895. Pp. 8.

We have already had occasion several times to call attention to the admirable work done by the Texas Weather Service in the publication of Special Bulletins relating to the climate and horticulture of that State. The seventh in the series of these Bulletins deals with Precipitation and the Flow of Rivers, considered in Relation to the Question of Irrigation, and is by Dr. Cline. The information contained in this publication is of much value to those interested in agriculture and horticulture in Texas, and will, undoubtedly, be thoroughly appreciated by them. Persons outside the State will also find in it matter of general interest in connection with the question of precipitation and irrigation. We presume that Dr. Cline will be glad to send out any of these Special Bulletins to those who make application to him.

TERRESTRIAL MAGNETISM.

Terrestrial Magnetism. An International Quarterly Journal. Published under the Auspices of the Ryerson Physical Laboratory, A. A. Michelson, Director. Edited by L. A. Bauer. 8vo. Chicago, The University of Chicago Press. Vol. I. No. 1, January, 1896. Two dollars a year.

It gives us great pleasure to call the attention of our readers to the new Journal, *Terrestrial Magnetism*, issued from the University of Chicago

Press. We have already printed in full the advance circular of *Terrestrial Magnetism* (see this JOURNAL for February), so that our readers are familiar with the general plan of the publication and with the Board of Associate Editors, which includes many of the men most eminent in meteorology and terrestrial physics. Dr. Bauer is well fitted to have charge of this new Journal, having but recently returned from several years of study in Germany, under von Bezold and others.

We wish *Terrestrial Magnetism* every success, and hope that it will receive the support it so well deserves.

TITLES OF RECENT PUBLICATIONS.

FURNISHED BY MR. OLIVER L. FASSIG, LIBRARIAN, U. S. WEATHER BUREAU, WASHINGTON, D. C.

(An asterisk [*] indicates that the publications thus designated have been received by the Editor of this JOURNAL.)

ANNALES DE L'OBSERVATOIRE ROYAL DE BELGIQUE. *Observations météorologiques d'Uccle* 1893 (*Oct., Nov., Dec.*) 4to. Bruxelles, 1894. pp. 181–240.

* FERGUSSON, S. P. *Anemometer comparisons at the Blue Hill Meteorological Observatory.* (Annals. Astr. Obs'y Harvard College. Vol. XL., part IV. Pp. 265–299. 3 pls. 4to. Cambridge, 1896.

HAMBURG. DEUTSCHE SEEWARTE. DEUTSCHES METEOROLOGISCHES JAHRBUCH FÜR 1894. *Ergebnisse der Meteorologischen Beobachtungen an* 10 *Stationen II. Ordnung und an* 45 *Signalstellen, sowie stündliche Aufzeichnungen an* 2 *Normal-Beobachtungsstationen.* Jahrgang XVII. Fol. Hamburg, 1895. VIII., 142 pp.

HONG KONG OBSERVATORY. *China coast meteorological register.* Jan. 1 to Dec. 31, 1894. Daily Fol. sheets.

* INDIAN METEOROLOGICAL MEMOIRS. Vol. VII., parts I. to IV. *Meteorological observations recorded at the Trevandrum Observatory during the years* 1853 to 1864, *under the superintendence of the late J. Allan Broun.* Edited by J. Eliot, Meteorological Reporter. Part I., Pressure. Part II., Temperature Observations. Part III. Vapor Tension. Part IV. Humidity. Fol. Simla, 1894–1895.

LICK OBSERVATORY. *Contributions from Lick Observatory No.* 5. *Meteors and sunsets observed by the astronomers of the Lick Observatory in* 1893, 1894, *and* 1895. 8vo. Sacramento, 1895. 86 pp. 17 pls. (Sunsets at Mount Hamilton. Some curious effects of refraction. By A. L. Colton. Pp. 73–80. Pls. VIII.–XII.)

LONDON. METEOROLOGICAL OFFICE. *Meteorological observations at stations of the second order for the year* 1891. (Appendix giving results for certain stations for the 15 years, 1876–1890.) Official No. 117. 4to. London, 1895. 195 pp. 1 pl.

LONDON. METEOROLOGICAL OFFICE. *Hourly means of the readings obtained from the self-recording instruments at the five observatories under the Meteorological Council,* 1891. Official No. 113. 4to. London, 1895. 140 [50] pp. 9 pls.

LONDON. METEOROLOGICAL OFFICE. *Daily weather reports. 1st January to 30th June,* 1895. 4to. London, 1895.

PRUSSIA. K. PREUSS. MET. INSTITUT. *Bericht des International Meteorologischen Comités und der Internationalen Commission für Wolkenforschung.* Versammlung zu Upsala, 1894. 8vo. Berlin, 1895. 45 pp.

* QUITO. OBSERVATORIO ASTRONOMICO. *Boletin. Ano* 1. No. 3. Diciembre de 1895. 8vo. Quito [1896]. [Met'l obs. for Dec., 1895, at Quito, and for April, May, and June, 1895, at Gualaquiza, Ecuador.]

SWITZERLAND. ANNALEN DER SCHWEIZERISCHEN METEOROLOGISCHEN CENTRAL ANSTALT, 1893. "*Der Schweizerischen meteorologischen Beobachtungen.*" 30. *Jahrgang.* 4to. Zürich [1895]. VIII. 376 pp. 9 pl.

SAXONY. K. SÄCHS. MET. INSTITUT. *Wetterbericht des Königl. Sächsischen meteorologischen Instituts in Chemnitz.* (Täglich.) 1 Jan. — 31 Dez. 1894. Single sheets obl. 4to. Chemnitz, 1894.

SAXONY. K. SÄCHS. MET. INSTITUT. *Das Klima des Königreiches Sachsen. Heft III. Monats- und Jahresmittel der wichtigsten. Klimatischen Elemente für den Zeitraum* 1864–1890. *Ergebnisse der Verdunstungs beobachtungen für den Zeitraum* 1883–1893. *Ergebnisse der Beobachtungen auf Thürmen für den Zeitraum* 1888–1893. 4to. Chemnitz, 1895. 65 pp.

*TEXAS WEATHER SERVICE. *Special Bulletin No. 7. Precipitation and the flow of rivers in Texas, considered in relation to the question of irrigation.* By Isaac M. Cline. 8vo. Galveston, 1895. 8 pp.

TRANSACTIONS OF THE AMERICAN CLIMATOLOGICAL ASSOCIATION. For the year 1895. Vol. XI. *Containing Part I. of the Report of the Committee on Health Resorts and a general index of Vols. I.–XI.* 8vo. Phila., 1895. XXVIII. 266 pp. 1 ch.

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